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Faculty Working Papers

PRICING OF LIQUIDITY FOR PREFERRED STOCKS ON
THE NEW YORK STOCK EXCHANGE

Frank K. Reilly, Professor, Department of Finance

#662

College of Commerce and Business Administration
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Faculty Working Papers

INFLATION AND THE HOUSEHOLD LIQUID ASSET
PORTFOLIO

Morgan J. Lynge, Jr., Assistant Professor,
Department of Finance

#668

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University of Illinois at Urbana-Champaign



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Summary

This paper investigates the impact of anticipated inflation on the level and composition of the household sector's liquid asset portfolio. Theory suggests that households should reduce holdings of money and fixed-dollar assets when inflation is anticipated. Demand equations for household holdings of five types of liquid assets are estimated using 1957:1 to 1975:4 data. Income and yield effects are accounted for. A survey measure of anticipated inflation is significant and show results for most liquid asset types indicating that households behave in the manner hypothesized by theory. This contrasts with some recent results reported elsewhere.

INFLATION AND THE HOUSEHOLD LIQUID ASSET PORTFOLIO

Over the past decade there has been a resurgence of interest in the effects of inflation on a wide range of economic decisions. Within this energetic renaissance an area of controversy involves questions of the impact of inflation on individual saving decisions [8, 9, 13, 16]. Two areas of concern may be identified. One involves the effect of inflation on the saving rate. That is, does the public save more, or less, in the face of inflation? A second area of concern, the chief focus of this paper, involves the effect of inflation on the composition of the public's assets and liabilities.

This study concentrates on the latter concern with a specific focus on the liquid asset portfolio of the household sector. We investigate the effect of anticipated increases in the price level on the composition of the household sector's liquid asset holdings. The next section presents a discussion of the theory and the results of several studies regarding the manner in which a rising price level affects portfolio composition. Following this a model is specified and estimated. The model attempts to identify the impact of anticipated inflation on the composition of the household liquid asset portfolio. Finally, conclusions are drawn on the basis of the empirical results.

1. Inflation and Household Liquid Asset Holdings

The household asset composition decision may be viewed as a process of structuring the portfolio of assets such that effective yields (adjusted for nonpecuniary returns and risk) on different assets are equal at the

margin. Thus, any phenomenon, including inflation, that alters the structure of effective yields on assets leads to a restructuring of the portfolio.

Central to the discussion of the effect of inflation on asset composition is a distinction between an "anticipated" rise in the price level and one which is "unanticipated." In a behavioral context, an anticipated rise in the price level is one that is fully expected and is explicitly taken into account by decision makers. The market impact of such adaptive behavior is to bring about an appropriate structure of interest rates, current prices, etc. Then, if the anticipated inflation is exactly realized, no further change in rates or prices is necessary. In contrast, unanticipated inflation emerges to the extent that actual price level changes differ from anticipations. The deviation, unanticipated inflation (plus or minus), by definition has not been previously taken into account in economic decisions.

It is anticipated inflation over future period(s) that induces households to adjust asset holdings. Unanticipated inflation exists only for some past period and is only relevant in an error learning sense in the formulation of new anticipations. It is true that the wealth position may be changed in real terms when unanticipated inflation occurs, but decisions concerning the holdings of nominal stocks of liquid assets will hinge on, among other things, anticipations about future rates of inflation. Households, at the beginning of any particular period, form anticipations about the rate of price change for the coming period. One argument in the anticipations function may be the amount of unanticipated inflation over the previous period (or the amount by which previous

anticipations were not realized.) These inflation anticipations then bring about a perceived change in the effective yields on assets and hence a restructuring of the portfolio.

Setting aside the question of whether the process outlined here is a useful description of the manner in which households factor inflation into their economic decisions, questions remain concerning just how portfolio decisions vary as the rate of inflation varies. A rise in the price level will depreciate the real value of holdings of money and other fixed-dollar assets. One would expect that households would react to an anticipated inflation by rearranging asset holdings and directing new acquisitions into assets or goods that will maintain their real value during inflation. This would suggest a reduction in money balances and fixed-dollar assets subject to rate ceilings and an increase in real assets and, perhaps, common stocks.

Cagan and Lipsey [1] cite evidence that such an active reallocation has not occurred in recent years of rising inflation. They report an increase in the holdings of fixed-dollar assets by households, contrary to the prediction of the theory. Taylor [13] also finds that the reaction to inflation by households is to increase saving primarily in the form of fixed-dollar liquid assets. One explanation for this result is a desire by households to increase the liquidity, or maintain liquidity in real terms, of their asset portfolios in the face of economic uncertainty associated with rising inflation.

While these results indicate increased holdings of liquid financial assets, the question being examined here is the extent of compositional changes within the portfolio of liquid assets in response to anticipated

inflation. Five categories of liquid assets making up the bulk of all liquid assets held by the household sector are examined. These are money (MON), including demand deposits and currency, time deposits at commercial banks (TD), shares at savings and loan associations (SAL), deposits at mutual savings banks (MSB) and treasury bills (BLS). Table 1 shows the nominal and real per capita holdings for 1957:1 and 1975:4, the beginning and end dates of the data used in their study. Both the nominal and real holdings of total liquid assets have increased, and they have increased relative to disposable income (see "ratio to income" line in Table 1.)

TABLE 1
Household Liquid Asset Portfolio, 1957:1 and 1975:4
(Stock amounts in \$ per capita)

	TOTAL LIQUID ASSETS	MON	TD	MSB	SAL	BLS
1957:1						
Nominal stock	1115.8	387.7	279.1	178.1	229.7	52.3
Real stock*	1343.2	466.7	336.0	214.4	266.4	59.7
Ratio to Income**	.629	.219	.157	.100	.125	.028
1975:4						
Nominal stock	4555.9	871.5	1670.4	512.5	1328.5	173.0
Real stock*	2752.8	526.6	1009.3	309.7	802.7	104.5
Ratio to Income**	.877	.168	.321	.099	.256	.033

*Real stocks are adjusted using the Consumer Price Index (1967=100).

**Ratios are per capita stock to per capita disposable income.

SOURCE: Flow of Funds Accounts, Federal Reserve Board.

The stocks of each liquid asset type have also all increased in nominal and real terms, but the ratio of stocks to income has declined for money balances (MON), remained approximately constant for mutual savings bank shares (MSB) and Treasury bills (BLS) and doubled for commercial bank time deposits (TD) and savings and loan association shares (SAL). What are the causes of these

liquid asset portfolio (relative) reallocations? More specifically, what role in this reallocation has anticipated inflation played?

2. The Model

To answer these questions empirically, demand equations for each liquid asset type will be formulated. For the purpose of analyzing the demand for each of these liquid asset types it is specified that households follow a two-tiered decision process. First, the household allocates resources across the categories of consumption, physical investment, and financial investment. Then allocation within each category follows as a second set of decisions as suggested by James Tobin [14]. The focus here is on the second tier, the allocation of resources to each of the liquid assets in the household sector portfolio.

A stock-adjustment framework is utilized. According to this framework, households formulate in each period a desired level of each asset included in the portfolio, A_{it}^* , where $i = \text{MON, TD, SAL, MSB, BLS}$. This desired level for period t is then compared to the actual level at the end of the previous period to determine the adjustment necessary to achieve the desired stock, as in (1). The constant λ_0 allows

$$(1) \quad A_t - A_{t-1} = \lambda_0 + \lambda_1 (A_t^* - A_{t-1}) \quad 0 < \lambda_1 \leq 1$$

for some drift in the process over time. The "speed of adjustment" coefficient, λ_1 , allows for a less than complete adjustment in levels in the current period. This lag in adjustment may reflect costs of adjustment as well as habit and momentum. Likewise, rapid adjustment may require a reduction in consumption in the short run (if, say, a sufficiently

high income elasticity of demand existed and income increased), and a household may prefer to spread the adjustment over time to avoid the disruption of consumption.

The desired level of each asset is not an observable quantity, but is assumed to be a function of a number of economic variables. The amount of resources to be allocated to any asset type should depend positively on its monetary yield as well as other nonpecuniary advantages, such as liquidity, safety, etc., and inversely on the corresponding advantages of other asset types. Furthermore, it is reasonable to suppose that income plays a role although the exact role is unclear for each asset type. As income increases it may be that the response is to increase liquid financial assets in the portfolio to maintain some desired proportionality between liquid and less-liquid assets. Alternatively, as income, and wealth, increases, some threshold level of liquid assets may be achieved beyond which a declining share of resources will be allocated to liquid assets.

The desired level of each asset is hypothesized to also depend on the anticipated rate of inflation. The hypothesized determinants of desired asset levels are shown in (2).

$$(2) \quad A_i^* = \alpha_0 + \alpha_1 i_0 + \alpha_2 i_c + \alpha_3 Y + \alpha_4 AI$$

where:

A_i^* = desired stock of asset i

i_0 = own rate or yield

i_c = competing rates or yields on deposit and/or market assets

Y = disposable income

AI = anticipated inflation

Substituting (2) into (1) gives (3) which is the model to be estimated for each liquid asset type.¹

$$(3) \quad A_{it} = \beta_0 + \beta_1 i_0 + \beta_2 i_c + \beta_3 Y + \beta_4 AI + \beta_5 A_{i,t-1}$$

where:

$$\beta_0 = \lambda_0 + \alpha_0 \lambda_1$$

$$\beta_j = \lambda_1 \alpha_j \quad j = 1, \dots, 4.$$

$$\beta_5 = 1 - \lambda_1$$

Asset stock and disposable income quarterly data come from the Federal Reserve Flow of Funds Accounts and are expressed in per capita levels. Deposit interest rates come from time series data used in the FMP model. The measure of anticipated inflation (AI) used here has been constructed by Juster from the quarterly surveys of the Survey Research Center at the University of Michigan. The survey asks for consumers' expectations of price changes over the next year. From these responses the average level of anticipated inflation can be calculated (see [6]). The use of measures of anticipated inflation obtained from survey data is gaining increasing use. A recent example of the use of such a measure to explain wage increases is [2]. Such a measure is not exempted from criticism but does offer an alternative to the use of past values of inflation to estimate expectations. The use of these survey data avoids the usual assumption that expectations of inflation can be proxied by a distributed lag on past inflation levels. Thus the test concerns only the effects of anticipated inflation on financial asset levels and not

also the test of the appropriateness of a distributed lag proxy of anticipated inflation [11].

The use of a competing market rate of interest along with a measure of anticipated inflation presents certain difficulties. It has been shown, for example, that the Treasury-bill rate as a market rate contains ". . . nontrivial information about the rate of change in purchasing power. . ." [4, p. 281]. If the Treasury-bill rate incorporates expectations about future rates of inflation then the inclusion of this variable as a competing rate and AI will result in multicollinearity. In addition the coefficient of the Treasury-bill variable would estimate in part the effect on asset levels of changes in the bill rate which are a result of changes in anticipated inflation. To eliminate the colinearity between the Treasury-bill rate and AI the following procedure is used (see [12] for an example of this approach). Equation (6) is estimated² where BLSRT is the 90-day new Treasury-bill rate (an average of monthly

$$(6) \quad \text{BLSRT}_t = \beta_0 + \beta_1 \text{AI}_t + \varepsilon_t$$

rates from the Survey of Current Business). The estimated residuals are used to capture the stochastic portion of the bill rate that is orthogonal to AI. This procedure attributes to AI whatever covariation exists between AI and BLSRT.

Having accounted for income and price (yield) effects, it remains to see the impact of anticipated inflation on liquid asset holdings. Theory suggests that the coefficient of AI should be negative for money and fixed-dollar assets, at least for the deposit assets whose nominal yields are constrained by ceilings during a good portion of the period

of study. The results of Cagan and Lipsey [1] and Taylor [13] suggest that the effect of AI on liquid asset holdings is likely to be positive.

3. Empirical Results

The model is estimated by ordinary least squares for the period 1957:1-1975:4. Because the lagged dependent variable is present as an independent variable, the Durbin-Watson statistic as a measure of serial correlation is biased toward a value of 2.00. Therefore, Durbin's h statistic is used [3]. The hypothesis that serial correlation is not present cannot be rejected at the 0.05 level for an h value greater than 1.645. When serial correlation is a problem, the model is re-estimated using the Cochrane-Orcutt procedure to adjust for first-order serial correlation. Since the data are not seasonally adjusted seasonal dummy variables have been included and are significant in most cases.

Table 2 presents the estimated coefficients for the five selected types of financial assets in the household sector liquid asset portfolio using nominal values. The lagged stock, interest rate, and income coefficients have the expected signs in most cases. The lagged stock coefficients indicate the speed of adjustment of actual to desired stocks. Holdings of money are adjusted most rapidly--70% in the first quarter--while savings and loan shares are adjusted slowly--3% in the first quarter. The negative own yield coefficient in the MON equation is due to use of the time deposit rate as the own yield for money. The remaining own yield coefficients are positive and the competing yield coefficients are all negative as expected. The income coefficient is positive and statistically significant in all cases. This suggests the interpretation

TABLE 2
Estimated Demand Equations for Five Types of Liquid Assets:
Nominal Stocks
1957:1-1975:4

Asset Stock	MON	TD	MSB	SAL	BLS
Constant	98.377** (5.91)	-91.272** (3.35)	-18.952** (4.77)	-42.135** (2.49)	10.557 (0.96)
Lagged Stock	0.3041** (2.74)	0.8534** (14.04)	0.9497** (25.66)	0.9663** (45.17)	0.7947** (10.66)
Own Yield	-7.2805* (1.51)	5.7406 (1.18)	5.5320** (3.96)	5.8716* (1.31)	6.9963** (3.72)
Competing Yield	-0.8245 (0.43)	-5.9630** (3.40)	-3.0068** (8.63)	-7.4379** (9.00)	-5.0164 (1.06)
Income	0.1137** (6.30)	0.0655** (2.68)	0.0077** (2.26)	0.0262** (4.55)	0.0052* (1.29)
Anticipated Inflation (AI)	-1.8259 (0.66)	0.9064 (0.36)	-3.4925** (6.44)	-9.7068** (7.64)	3.8857* (1.33)
Seasonal Dummies:					
Q ₁	-41.580** (7.01)	6.9349** (2.39)	1.8824** (3.37)	-0.2492 (0.16)	6.9588** (2.23)
Q ₂	-30.747** (6.60)	1.2648 (0.39)	-1.2967** (2.05)	-0.5261 (0.31)	-6.6730** (1.91)
Q ₃	-29.680** (6.42)	3.4888 (1.23)	-1.4291** (2.60)	-6.6422** (4.37)	4.7350* (1.52)
\bar{R}^2	.99127	.99842	.99896	.99944	.81328
SE	14.176	10.287	2.000	5.216	10.835
h	3.33	0.413	1.319	0.699	1.217

Numbers in parentheses are absolute value t-statistics.

**Significant at 0.05 level; *Significant at 0.10 level.

that as income grows the liquid asset portfolio is increased to maintain or increase liquidity. But since the income elasticities, calculated at the mean, are all less than one (they range from 0.074 for MSB to 0.620 for MON) liquidity in the form of these assets cannot be considered a luxury good.

The coefficients of the anticipated inflation variable (AI) is the focus of interest here. The coefficients of AI for the MON and TD equations are not significant, implying that money and time deposit holdings are not altered systematically in response to anticipations of inflation. The remaining two deposit assets, SAL and MSB, do exhibit negative and significant AI coefficients, as would be predicted from the net monetary creditor/debtor view of how households adjust to inflation.

For the BLS equation the AI coefficient is positive and significant at the 0.10 level. This coefficient can be viewed as capturing the full effect of anticipated inflation on Treasury bill holdings since all AI effects have been removed from the Treasury bill own yield. Household holdings of BLS therefore respond in a completely different way to anticipations of inflation than do holdings of the other liquid assets examined here. Since there are several characteristics of BLS that are considerably different from other liquid assets included it is difficult to identify exactly what accounts for this different behavior in the face of anticipated inflation. The combination of short maturities, and market determined yield (not subject to regulatory ceilings) as well as the credit riskless nature of BLS may make them an attractive vehicle for investment when inflation is expected to increase. The minimum denomination of \$10,000 in effect during the last five years of the period

being examined may have restricted this asset form to those households with larger portfolios. However the coefficient measured here is for the household liquid portfolio in the aggregate thus indicating the magnitude of household holding of BLS.

Taking the liquid assets examined here as a whole, the net reaction to anticipated inflation is a reduction in the nominal value of the portfolio, presumably in favor of real assets, although this presumption has not been tested here. (See [10] for evidence on substitution between real and financial assets.)

The results reported in Table 2 are estimated using nominal (per capita) values for asset stocks and income. If households are rational and strip away the veil of money illusion, portfolio decisions are made in real terms. Reestimating the demand equations using real (per capita) values, results in the estimated coefficients for the anticipated inflation (AI) variable shown in Table 3. The income, yield and lagged stock coefficient estimates were similar to those in Table 2 and are not presented here. Expressing per capita asset stocks and disposable income

TABLE 3
Estimated Coefficients of Anticipated Inflation Variable: Real Stocks
1957:1-1975:4

Asset Stock	MON	TD	MSB	SAL	BLS
AI Coefficient	-4.9312** (2.35)	-3.3893** (1.69)	-3.9981** (8.37)	-9.9490** (7.81)	5.8529** (2.40)

Numbers in parentheses are absolute value t-statistics

**Significant at 0.05 level.

in real terms causes the coefficients of AI to be statistically significant for all liquid asset types. For money and the deposit assets the coefficients are negative; again, as in the nominal case, the AI coefficient for Treasury bills is positive. These results support the general theoretical prediction that anticipated inflation causes households to reduce holdings of fixed-dollar assets.

Uncertainty about the future, perhaps exacerbated by uncertainty about future inflation, has been mentioned as a factor affecting saving and portfolio behavior [7, 13, 15]. Some empirical results suggest that this uncertainty leads to a reduction in consumer credit [15] or an increase in liquidity [13].

As a test of the impact of inflation uncertainty on the demand for liquid financial assets by households, the demand equations were re-estimated with an additional variable representing inflation uncertainty. Inflation uncertainty is measured by the variance of inflation expectations (VAI). This measure has been constructed by Juster [6] utilizing the distribution across households of responses to a question about inflation expected over the next year. This measure of inflation uncertainty has been used by Juster and Taylor [7] and Wachtel [15].

Coefficient estimates of the anticipated inflation (AI) and the variance of anticipated inflation (VAI) are shown in Table 4. The AI coefficients have not changed in sign or significance. The only significant VAI coefficients (TD and BLS equations) are negative, indicating a reduction of holdings in response to greater uncertainty about future inflation.

TABLE 4
Estimated Coefficients of AI and VAI: Nominal Stocks
1957:1-1975:4

Asset Stock	MON	TD	MSB	SAL	BLS
AI Coefficient	-2.3062 (0.75)	2.9929 (1.16)	-3.4475** (6.12)	-9.5744** (7.25)	5.2644** (1.87)
VAI Coefficient	0.4740 (0.37)	-2.3920** (2.80)	-0.0553 (0.30)	-0.2068 (0.41)	-2.3813** (2.53)

Numbers in parentheses are absolute value t-statistics

** Significant at 0.05 level.

The preponderance of the empirical evidence reported here supports the general theoretical approach that households will reduce money and fixed-dollar assets when inflation is anticipated. In addition, the impact of the uncertainty associated with anticipated inflation is also in the direction of reducing asset balances as uncertainty increases.

4. Summary and Conclusions

The results presented here tend to support the theoretical approach that suggests that households in the aggregate will rearrange their liquid asset portfolios, once income and asset yields are accounted for, by reducing holdings of money and deposit assets in the face of anticipations of a rising price level. This result is contrary to results obtained by some [1, 13] that households, in times of rising inflation, increase the holdings of the very liquid assets that will suffer the greatest depreciation.

These results were obtained by estimating demand equations that include a direct measure of anticipated inflation for consumers. The

measure of anticipated inflation is a survey variable, rather than merely a function of past observed inflation rates. This allows a direct test of its impact on asset holdings rather than a joint test which would include a test of the manner in which anticipations are formed. A market interest rate is used as an explanatory variable in a manner that removes the covariance between market rates of interest and anticipated inflation. This procedure allows the separation of the substitution effect of competing financial assets from the effect of anticipated inflation on asset holdings.

M/E/4

FOOTNOTES

1. The aggregate holdings of these five assets do not have a budget constraint. Therefore, each equation is estimated separately rather than as a system of simultaneous equations.
2. The estimated equation is $BLSRT = 1.664 + 1.194 AI$ with an adjusted R^2 of .724. The numbers in parentheses are absolute value t-statistics.
 $(7.49) \quad (14.07)$

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Faculty Working Papers

RANDOM ORDERINGS AND THE RANDOM UTILITY MODEL
WITH INDEPENDENTLY IDENTICALLY DISTRIBUTED ERRORS

L. G. Thomas, Assistant Professor, Department
of Economics

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College of Commerce and Business Administration
University of Illinois at Urbana-Champaign

Notes

¹We required the firms to be listed during the entire sample period. The Center for Security Price Research (CRSP) monthly tape was used to select NYSE listed firms. A firm was considered listed if it had monthly stock returns available for the entire sample period.

²The absolute percentage error is computed as the average of $\left| \frac{\text{Actual EPS} - \text{Predicted EPS}}{\text{Actual EPS}} \right|$. Since this error metric can be explosive when the denominator approaches zero we truncated errors in excess of ten to a value of ten. This operation was done for a very small percentage of the cases.



